Space Weather Technical Forecast

Issued on Saturday 18 January 2025 at 00:12 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1/R2 Expected. Chance of G1, easing later in the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 was Moderate, with several M-class flares observed, mainly emanating from AR3964 and peaking here with an M7.4 at 17/1335UTC.

There are now eight numbered sunspot regions on the Earth-facing disc. Foremost amongst these are AR3964, which has undergone rapid development in the past 48 hours to reach Dki/BGD complexity, although this growth has been slower in recent hours. There remained some significant emergence of intermediate spots and penumbral growth in the trailer, although many of the central spots later migrated westwards to merge with the leading group. A Mt Wilson delta remains in this leading cluster. Also of note was the largest sunspot region on the disc, AR3961 in the southeast, which is now an Ekc/BGD. This group also saw significant emergence of its central spots and an overall spreading trend. Other regions on the disc generally showed more languid growth or else were stable simple dipoles or unipoles.

A coronal dimming occurred around 17/1500UTC, apparently associated with activity immediately southeast of AR3864. At the time of writing, no obvious Coronal Mass Ejection was in evidence, and no Earth-bound CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured at L1 by ACE, were characterised by fast wind influence, likely to be connection to CH09/-, with the phi angle negative (towards the Sun) throughout. The solar wind speed showed an uptick from 17/0700UTC, after which previously Slightly Elevated solar winds and lows near 400km/s rose in earnest to reach Elevated and eventual highs near 600km/s by the period's end. The solar wind density showed the opposite tendency, highest early in the period near 10ppcc but falling into single-figures ppcc with the coronal hole's development. The IMF showed Slightly Elevated highs near 11nT through mid-period, starting and finishing nearer Background levels. The north-south component was erratic between -11 and +9nT.

The net result of the above solar wind measures was Quiet to Active, with a provisional peak Kp of '4o' seen in the 03-06UTC and 18-21UTC intervals.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels, despite M-class activity.

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High energy electron flux (greater than 2MeV) at GOES16 was at Normal Background to Moderate levels, with a peak of 764pfu at 17/1540UTC, but with the associated 24-hour fluence remaining below the Active threshold. This figure reached 1.22e7 integrated pfu at 17/2359UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is Expected, with occasional M-class flares. There is a now slightly raised Slight Chance of X-class flares, most likely emanating from AR3964 in the northwest, or perhaps AR3961 in the southeast.

Solar Wind / Geomagnetic Activity: No CMEs feature in the forecast, which solely comprises the ongoing effects of the current coronal hole fast wind from CH09. This should give a Chance of G1 on the first two days of the period, falling away during Tuesday 20 January to leave a Quiet midweek period.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux carries a daily Slight Chance of S1, rising slightly with the westward advance of the most complex group and raised slightly relative to recent guidance given the increased cadence of potentially suitable flaring events.

GOES16 high energy electron flux will initially be attenuated with geomagnetic activity arising from CH09, however it then carries a Chance of rebounding at GEO towards midweek UTC to reach Active 24-hour fluence and High diurnal peaks of flux.

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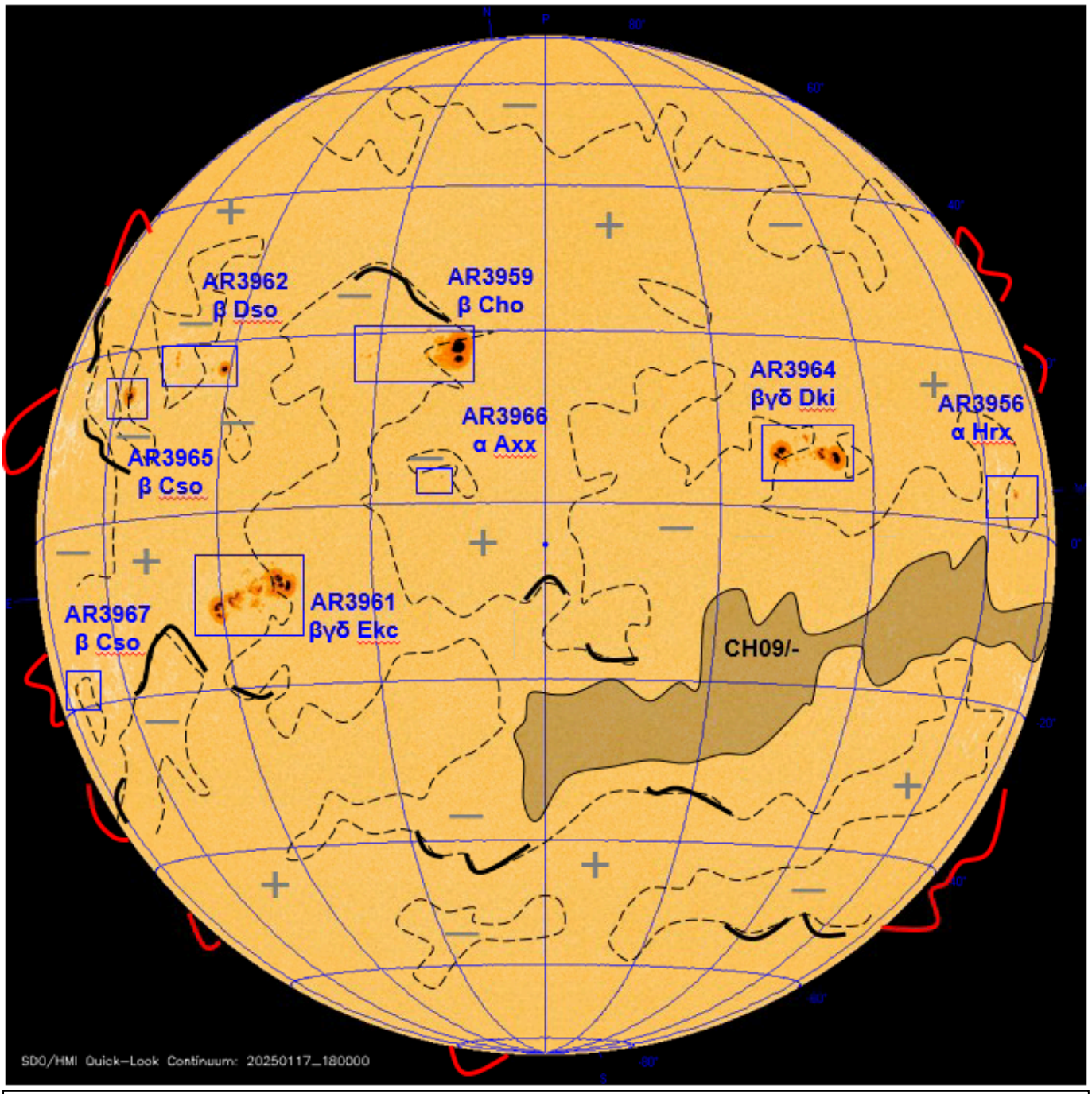
Figure 1: Solar synoptic map, valid 17/1800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-bound CMEs feature in the forecast.

The sole geomagnetic consideration for the forecast is the persistent but much-changed broad coronal hole across the centre of the disc, CH09/-. Due the longitudinal width of this feature, fast wind influence is likely to be protracted, with Elevated solar winds of 600km/s expected to be reached at times. This feature should retreat from the solar equator with time, such that its effects should have ceased by midweek UTC at the latest, and perhaps by Tuesday 20 January. Relative to its last pass, it is wider and more intense in EUV, and the chances of Minor Geomagnetic Storm G1 intervals are therefore higher and more spread in time, even without the additional consideration of being relatively further from the solstice.

This ongoing enhancement is supported in MOSWOC Enlil output, although this is perhaps slightly over-estimating the longevity of the feature and the peak wind strength.

There is a Chance of G1 Minor Geomagnetic Storm intervals for the remainder of the UTC weekend and into Monday 19 January, with the chances then falling through Tuesday to leave mainly Quiet conditions by the final day of the period.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	30	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: Past and current rotations of GOES16 EUVI 195 imagery, showing the much larger and more intense present manifestation of CH09, which is expected to increase its resultant peak geomagnetic activity and its duration.

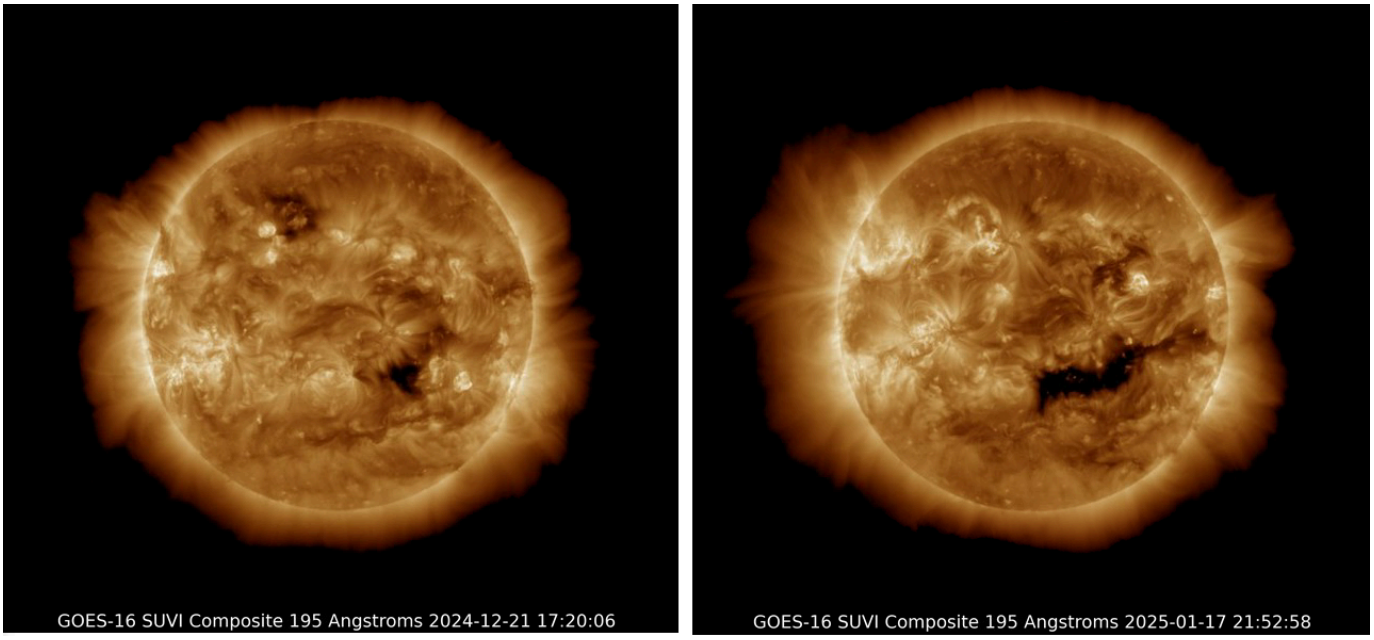
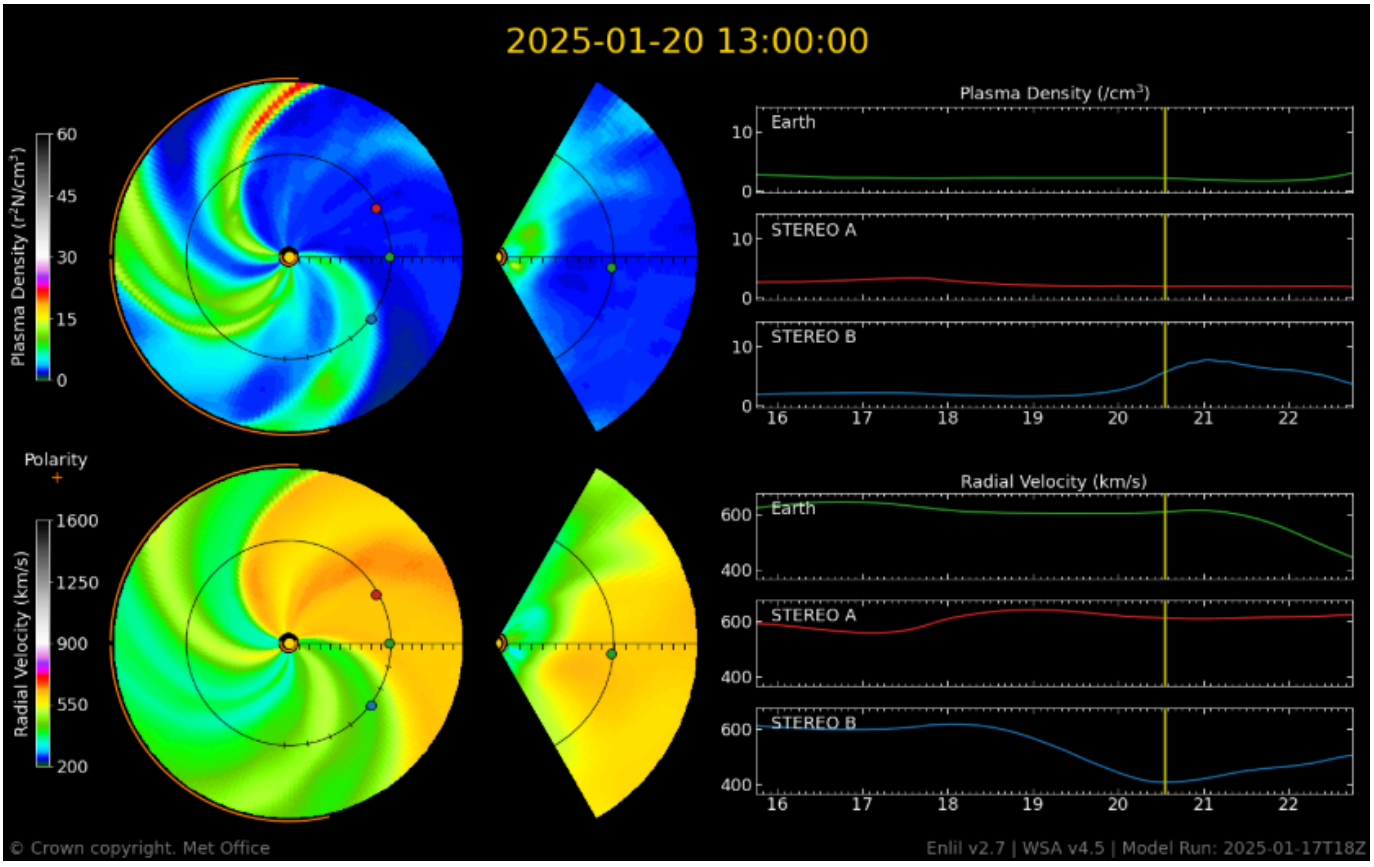


Figure 3: Latest MOSWOC Enlil run (badge time 17/1800UTC), showing a protracted contribution from CH09, perhaps overdone in terms of longevity and the persistence of the peak speed near 600km/s. No Earth-bound CMEs are currently in the model.



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Radio Blackouts - X-Ray Flares

The chances of both M and X-class flares are now higher than in recent guidance, with no fewer than seven M-class flares observed in the UTC day of Friday 17 January, including a peak M7.4.

No significant regions leave the disc in the period, with AR3964 expected to lie near the western limb by the final day of the four. As for oncoming regions, far side soundings are showing little evidence of large regions, however the returning Carrington locations for several regions lie just over the eastern solar horizon. All considered, the current rapid growth and complexity of AR3964, when taken with the scale of AR3961 and any arrivals may mean that M-class activity is now Expected in the near-term, perhaps relaxing a little as these groups mature and their growth slows.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	70	60	60
Very Active	R3-R5 (X Class)	No	20	20	15	15

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has remained at Background levels over the last 24 hours - this despite numerous M-class flares from the northwestern quadrant. The chances of S-scale events should gradually increase in the coming days as AR3964 edges ever westward, with the level of risk also increased throughout given the rapid growth and increased magnetic complexity of this group. Other regions are minor contributors by comparison, however AR3961 may start to play a more dominant role towards the middle of the coming working week.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 is currently showing diurnal peaks within Moderate levels, although this appears to have been attenuated at GEO by geomagnetic activity arising from CH09's fast wind in the past UTC day. The chances of Active electron fluence can be expected to increase as the influence of CH09 wanes into the new week, with recently observed Elevated solar winds now making exeedence marginally more likely. CH09 is substantially larger and more intense in EUV imagery than on last pass, and as such MOSWOC REFM may underdo the extent of any rebound at GEO into the new week (versus persistence of the smaller and fainted predecessor coronal hole), with a Chance of Active fluence being attained. This is hinted at in the latest run, with the forecast trace running above persistence to end its 72-hour range near the Active fluence threshold.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	10	50	50
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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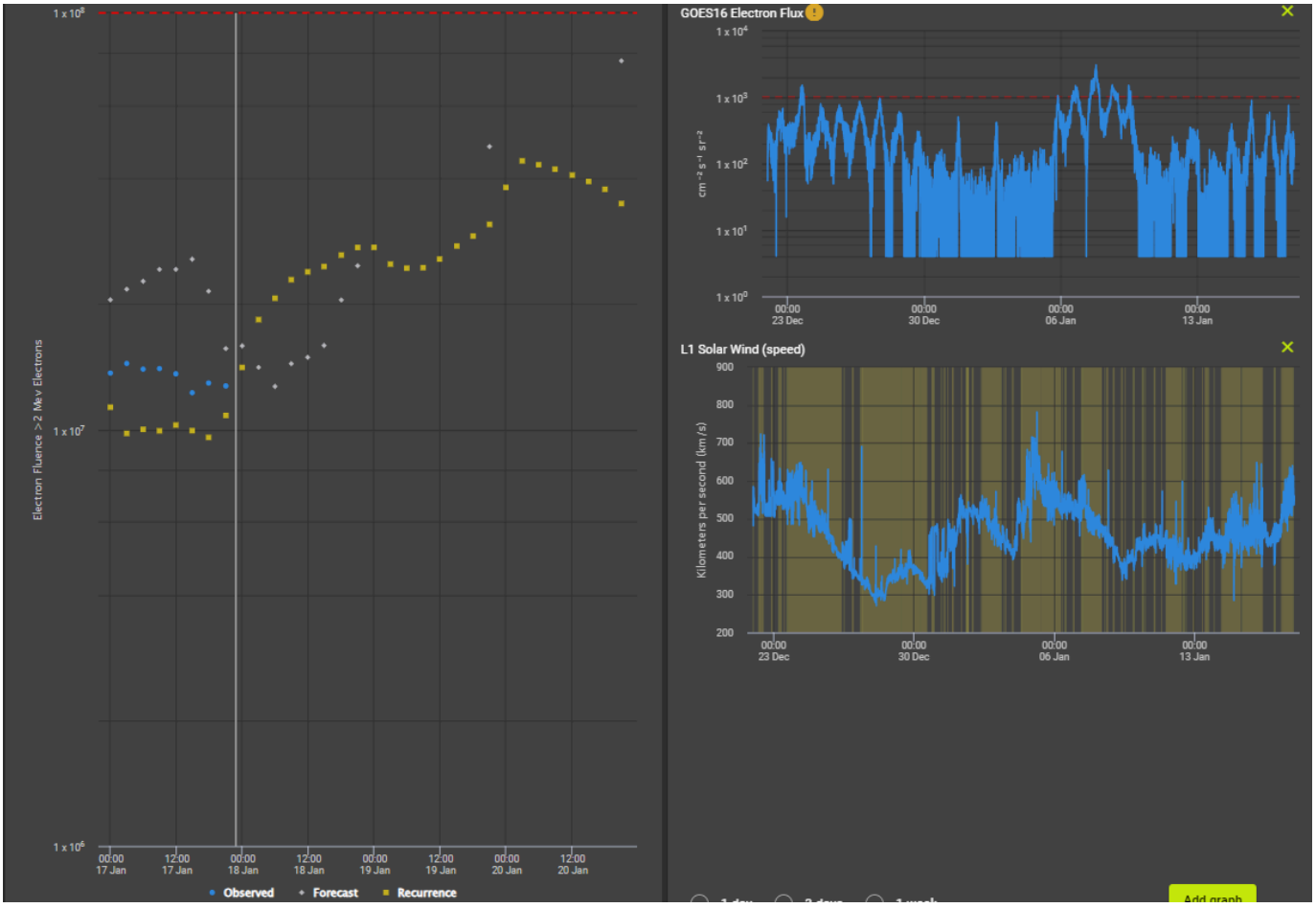
Figure 4: Latest MOSWOC REFM, showing rising trend that is accepted and may even be slightly underdone. Also shown is 27-day GOES16 electron flux and driving L1 solar wind speed. Note that High diurnal flux was reached around 25 days ago, and given the expected stronger contribution from current CH09, this may be more protracted and higher than on last pass, especially considering the forecast absence of interrupting CMEs.



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